## 2.18 OU 7-13/14 Treatability Study Area

The ISG test pit was constructed during August 2000 in the Cold Test Pit South upper area which is located on the South side of the Radioactive Waste Management Complex Subsurface Disposal Area. The pit was excavated to a depth of 12-ft. Pit construction consisted of four layers of simulated waste placed in 2-ft layers. With one exception identified above, each of the surrogate waste forms were placed in accordance with the layout described in the Engineering Design File (EDF) (INEEL-EXT-2000-00819, July 2000).

The following pictures indicate orientation and contents of selected waste forms.

ISG Pit prior to setting Waste Forms – Taken from the Northeast corner. The pit dimensions were 15 ft. × 15 ft. This was a change from the 14 × 14 identified in the EDF.


Northeast Corner

### 2.18.1 LAYER 1

Layer 1, Box 24-2, picture 1

Layer 1, Box 24-2, picture 2

Layer 1, Box 24-3, picture 3

Layer 1, Surrogate Waste Orientation, Drum 10-2 was placed in the vertical position rather than horizontal as indicated in the EDF.

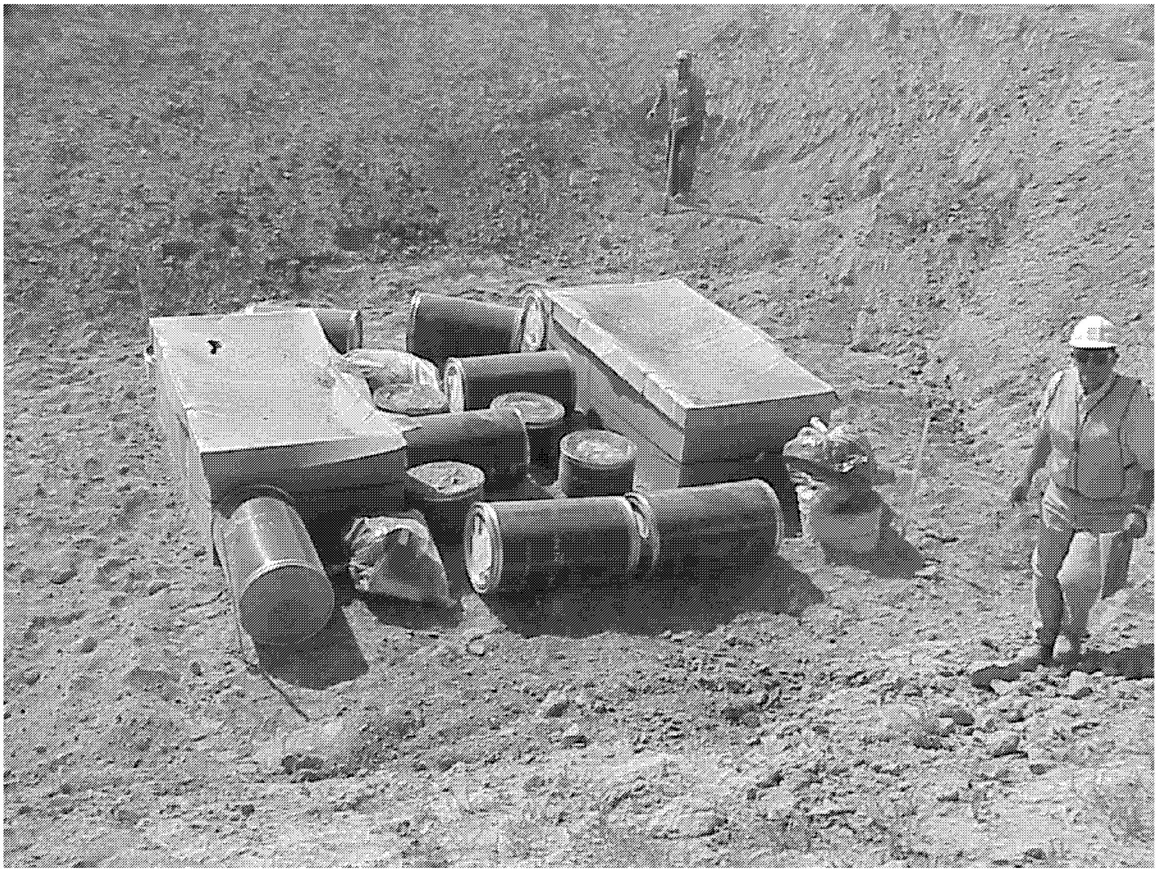
Northeast Corner

Drum 10-2, Vertical Placement

The position of each waste form was surveyed after placement. This picture shows the corners of Layer 1 being surveyed after placement and after being covered with a layer of dirt.

### 2.18.2 LAYER 2

Layer 2, Surrogate Waste Orientation



Northeast Corner

Backfilling Layer 2

Southwest Corner

### 2.18.3 LAYER 3

Layer 3, Surrogate Waste Orientation

Southwest Corner

Layer 3, Picture 2

Northeast Corner

### 2.18.4 LAYER 4

Layer 4, Surrogate Waste Orientation

Southwest Corner

Layer 4, Picture 2

Northeast Corner

ISG Pit After Backfill to Grade

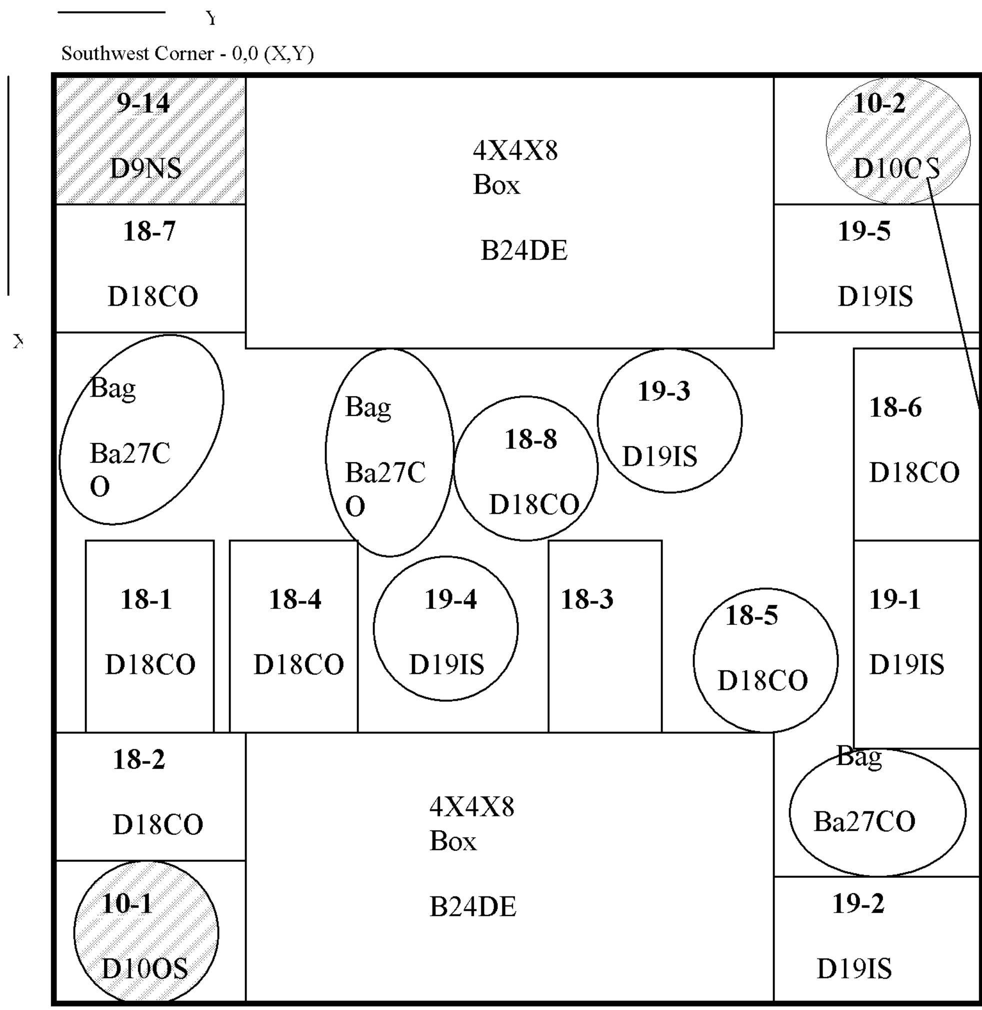
The following pictures depict As-Built information.

Notes:

1. Surrogate waste forms are indicated by number, type, and location (x,y,)
2. Green hash marks indicate organic sludge drums.
3. Red hash marks indicate nitrate salt drums.
4. The x and y coordinates show the distance in feet from the (0,0) coordinates in the southwest corner.

# As-Built for LAYER 1, 0-2 FT., Includes Numbers for Surrogate Waste Forms

**North**




DRUMS

D18CO =8

D19IS = 5

D10OS= 2

D9NS= 1

TOTAL = 16

Scale 1” = 2.5’

CO-Combustibles

IS-Inorganic Sludge

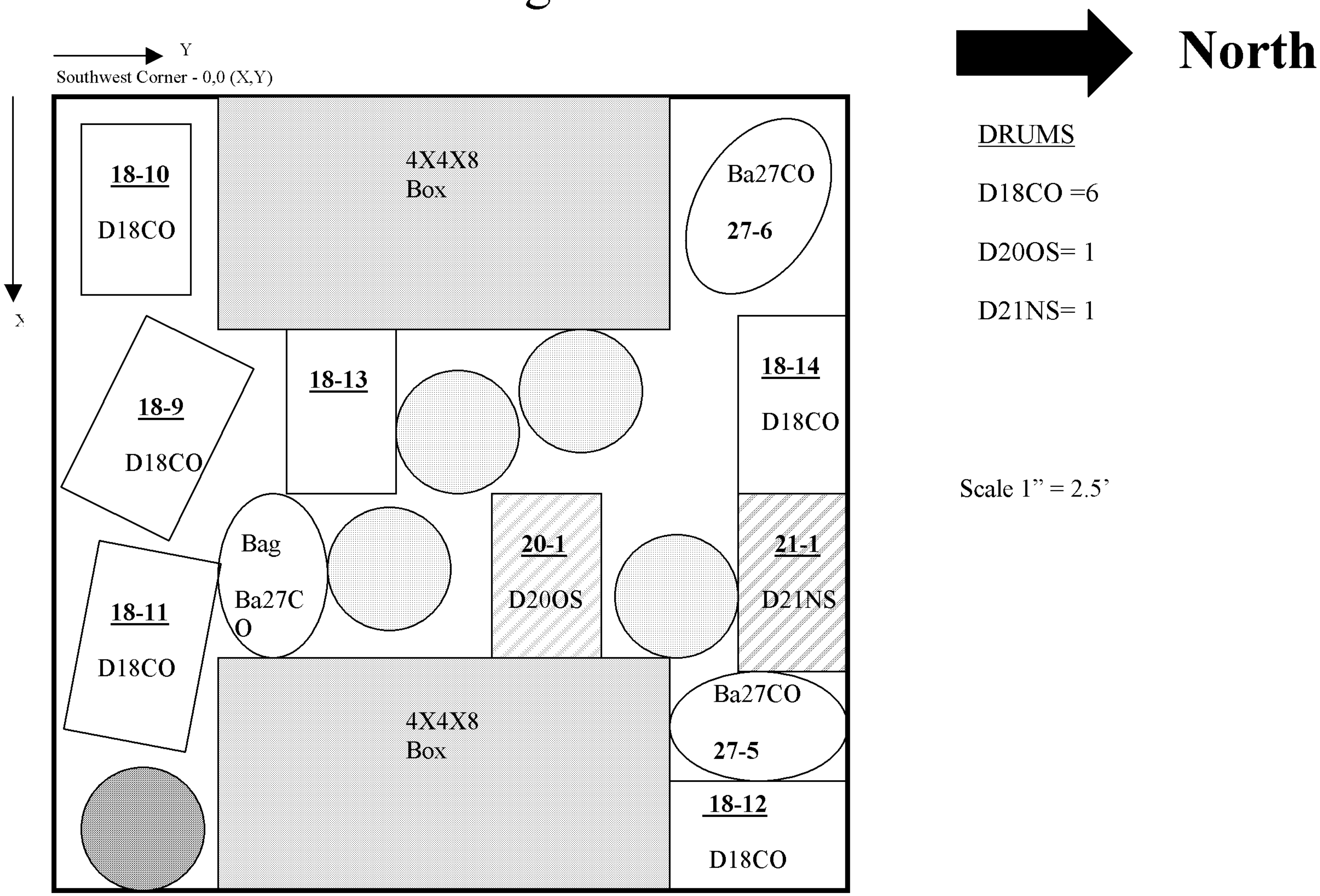
OS- Organic Sludge

NS- Nitrate Salt

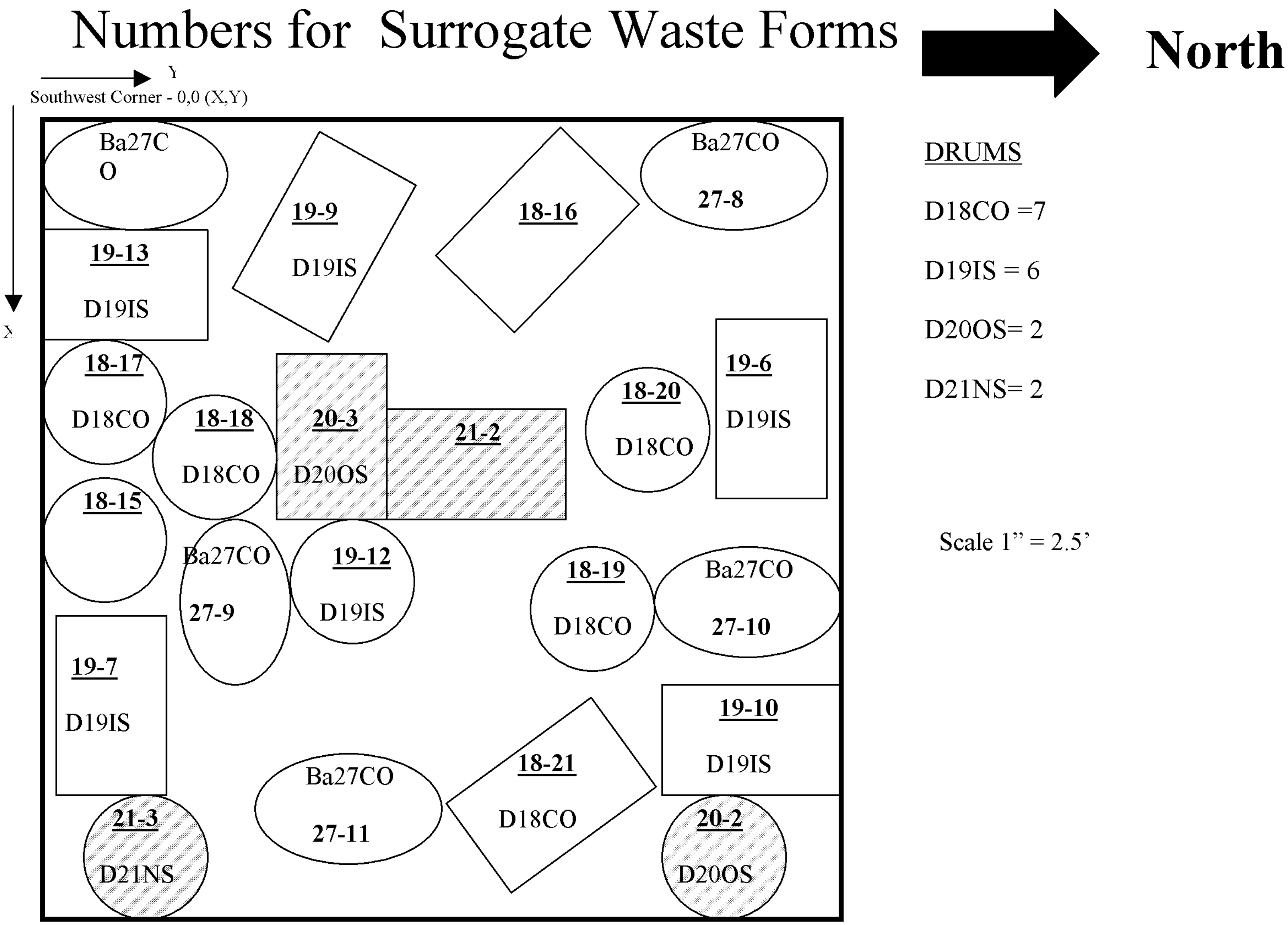
DE-Debris

**Drum 10-2 was installed in a Vertical Position instead of horizontal**

# As Built for LAYER 2, 0-4 FT., Includes Numbers for Surrogate Waste Forms



# As-Built for LAYER 3, 0-6 FT., Includes Numbers for Surrogate Waste Forms




DRUMS

D18CO =7

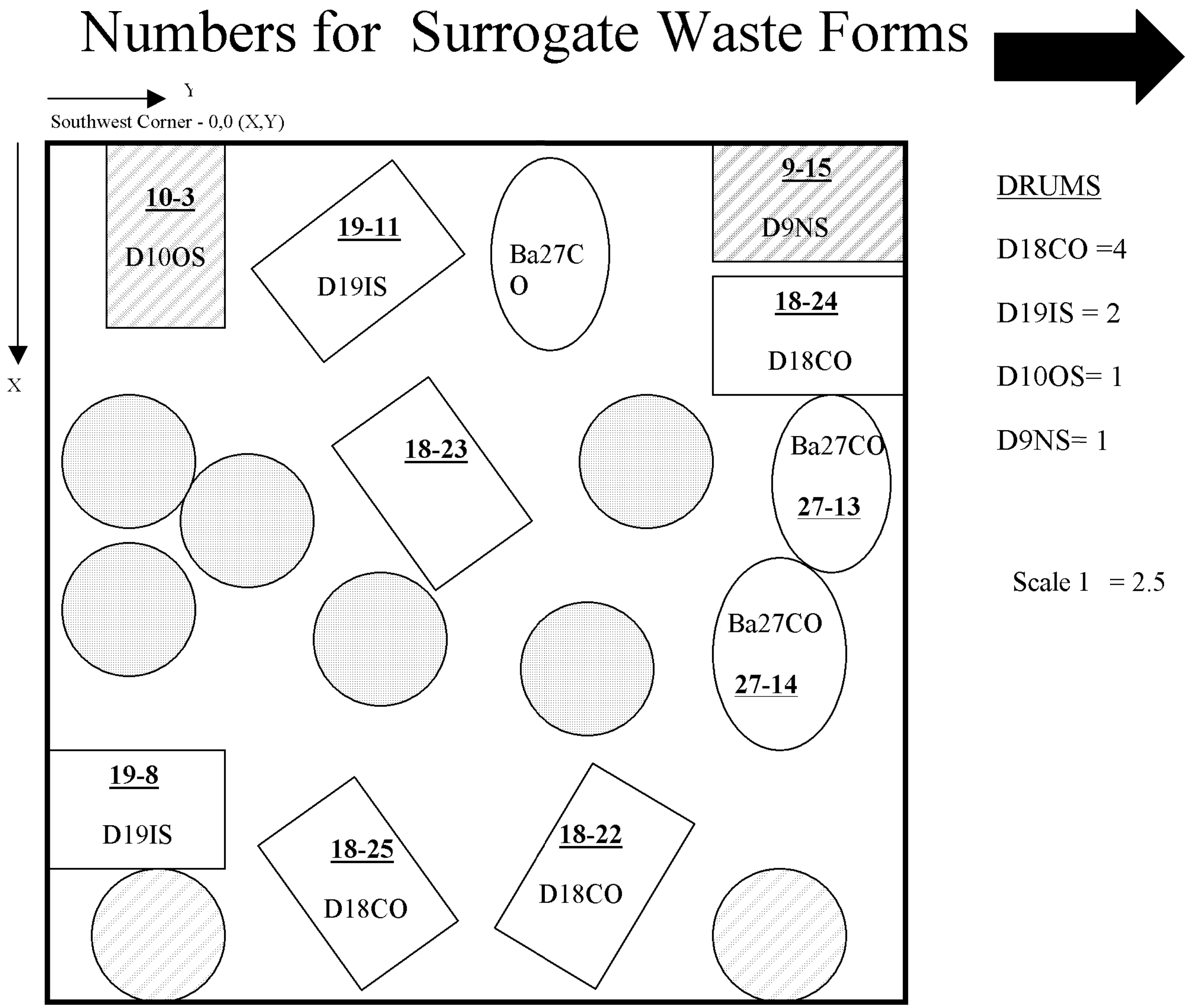
D19IS = 6

D20OS= 2

D21NS= 2

Scale 1” = 2.5’

# As-Built for LAYER 4, 0-8 FT., Includes Numbers for Surrogate Waste Forms




DRUMS

D18CO =4

D19IS = 2

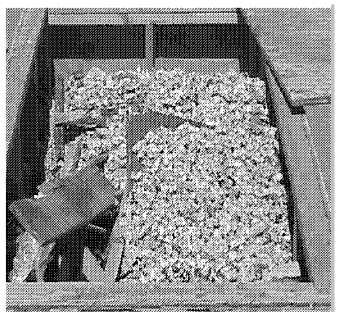
D10OS= 1

D9NS= 1

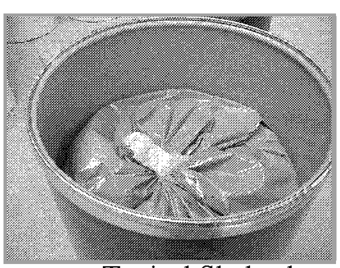
Scale 1 = 2.5

## 2.19 Typical Surrogate Waste Forms and Materials

Typical Barrel   Typical box combustibles   Typical box metals, asphalt



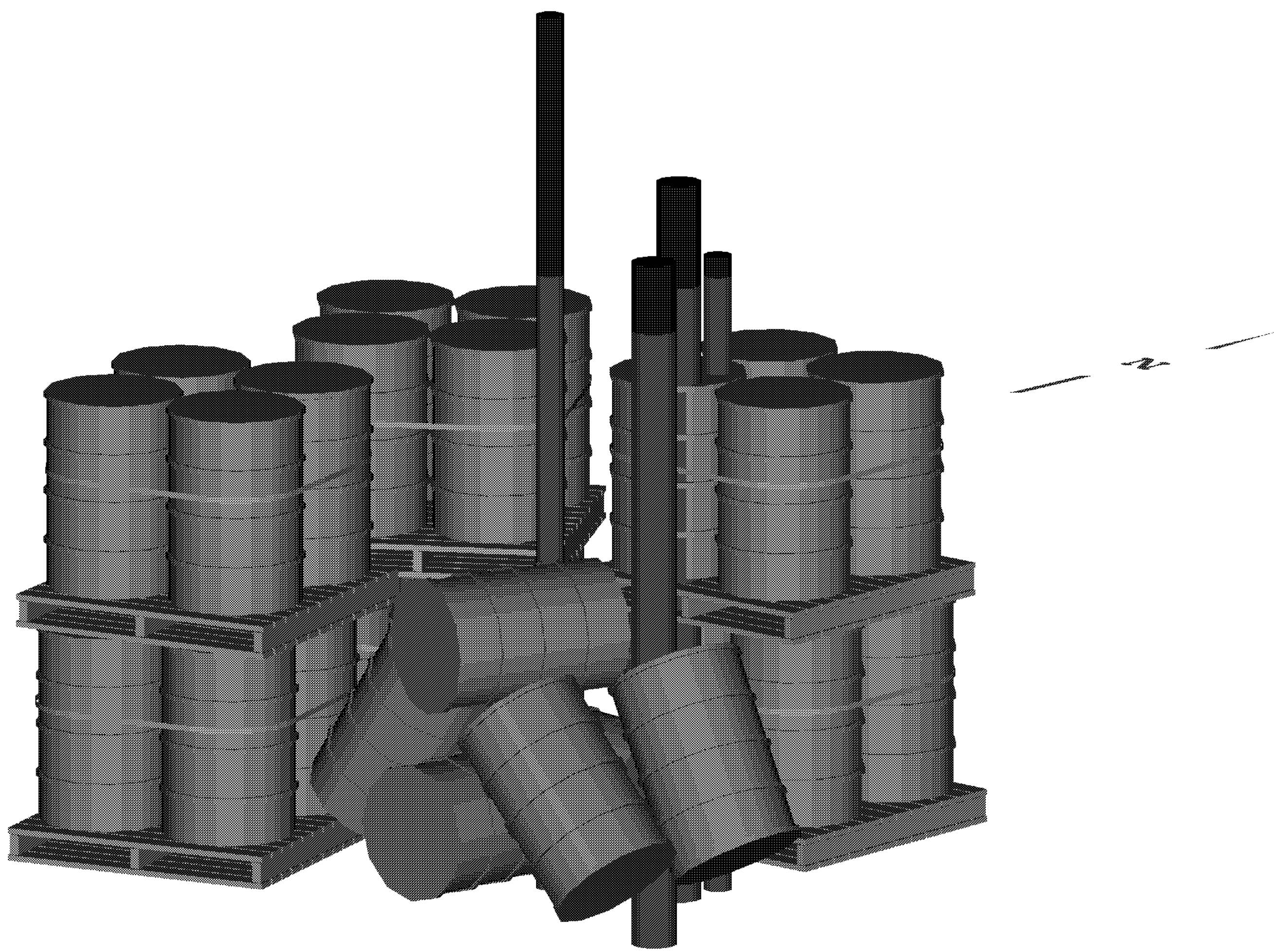
Typical Soils   Combustible bags   Barrel of combustibles



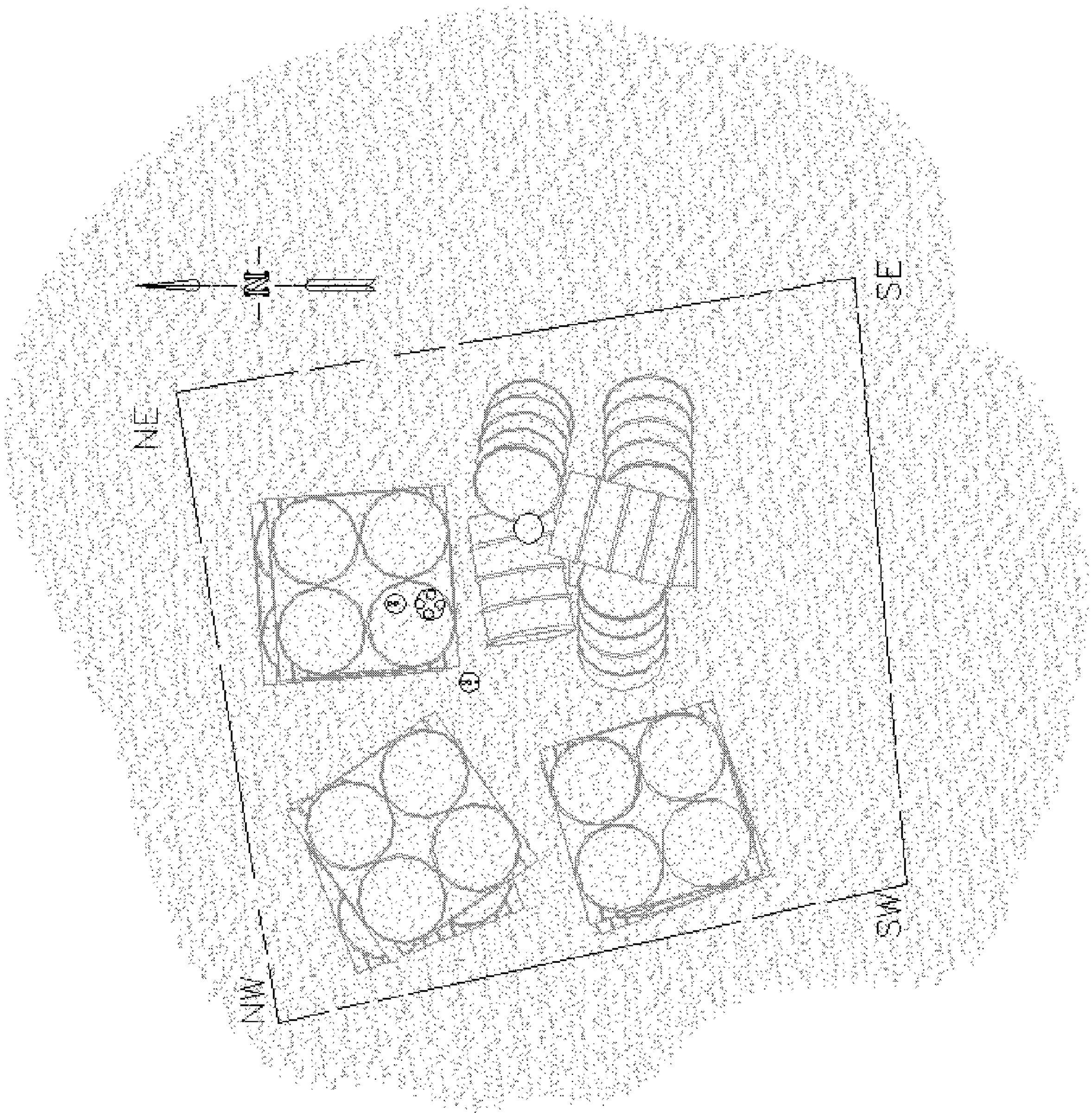
Typical Sludge barrel

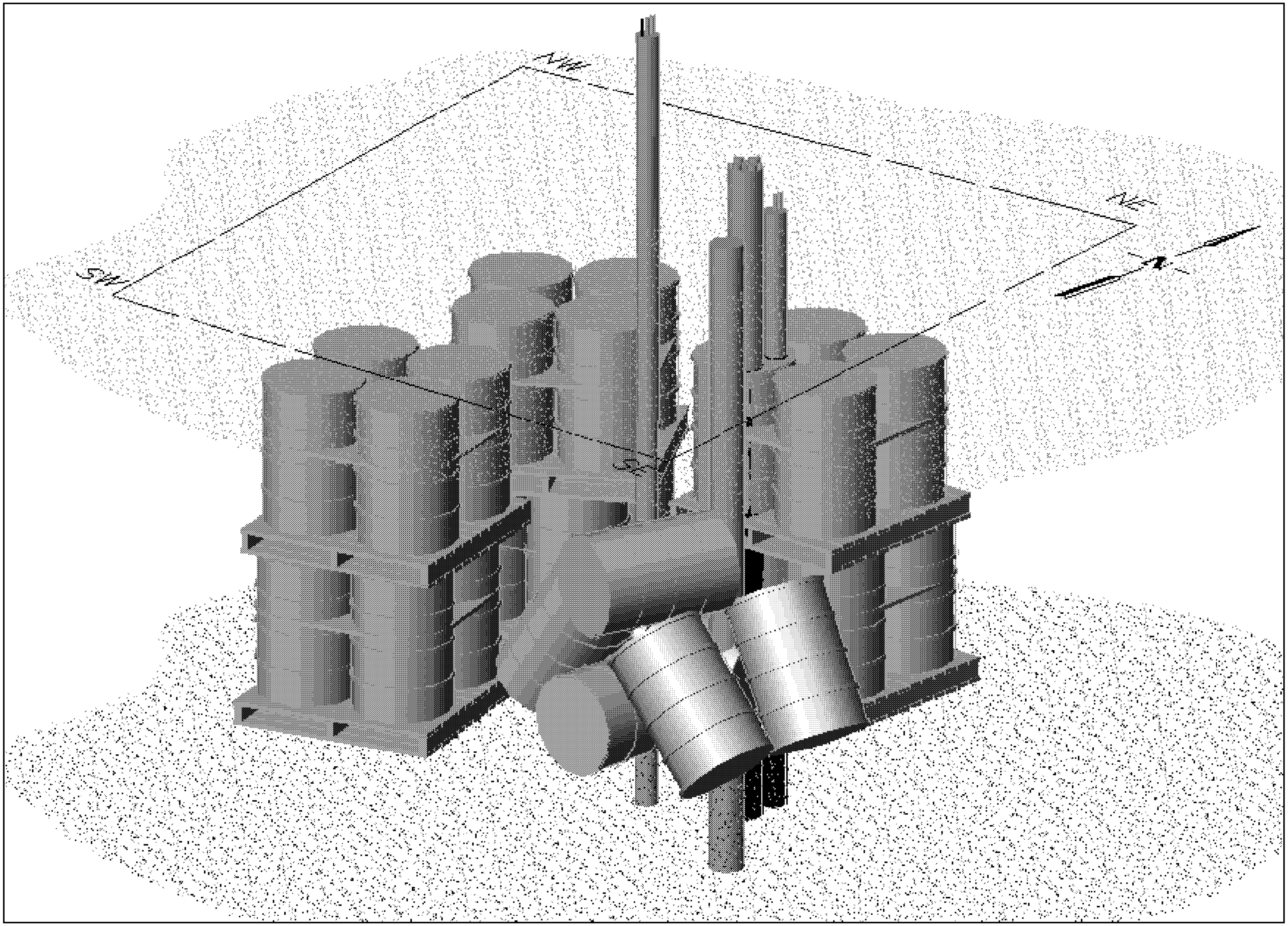
## 2.20 OU 7-10 and OU 7-13/14 Pit Coring and Probing Study Area

The pit 9 Coring and Probing Demonstration Pit was constructed in 1998. The purpose for this Pit Study Area is to demonstrate probehole installation and to test coring techniques using a sonic drilling rig fitted with a coring tool designed to operate in the heterogeneous waste materials anticipated in Pit 9. The dimensions for the test pit are 14 ft. × 14 ft. × 8 ft. deep. Details for construction of the pit is described in INEEL/EXT-99-00741, January 2000, Revision 1, and Test Plan for Cold Testing of Operable Unit 7-10 Stage I Coring Activities. Several types of probes were driven through the waste seam during 1999 and 2000. The pit contents and several Probes remain inserted in the pit area.

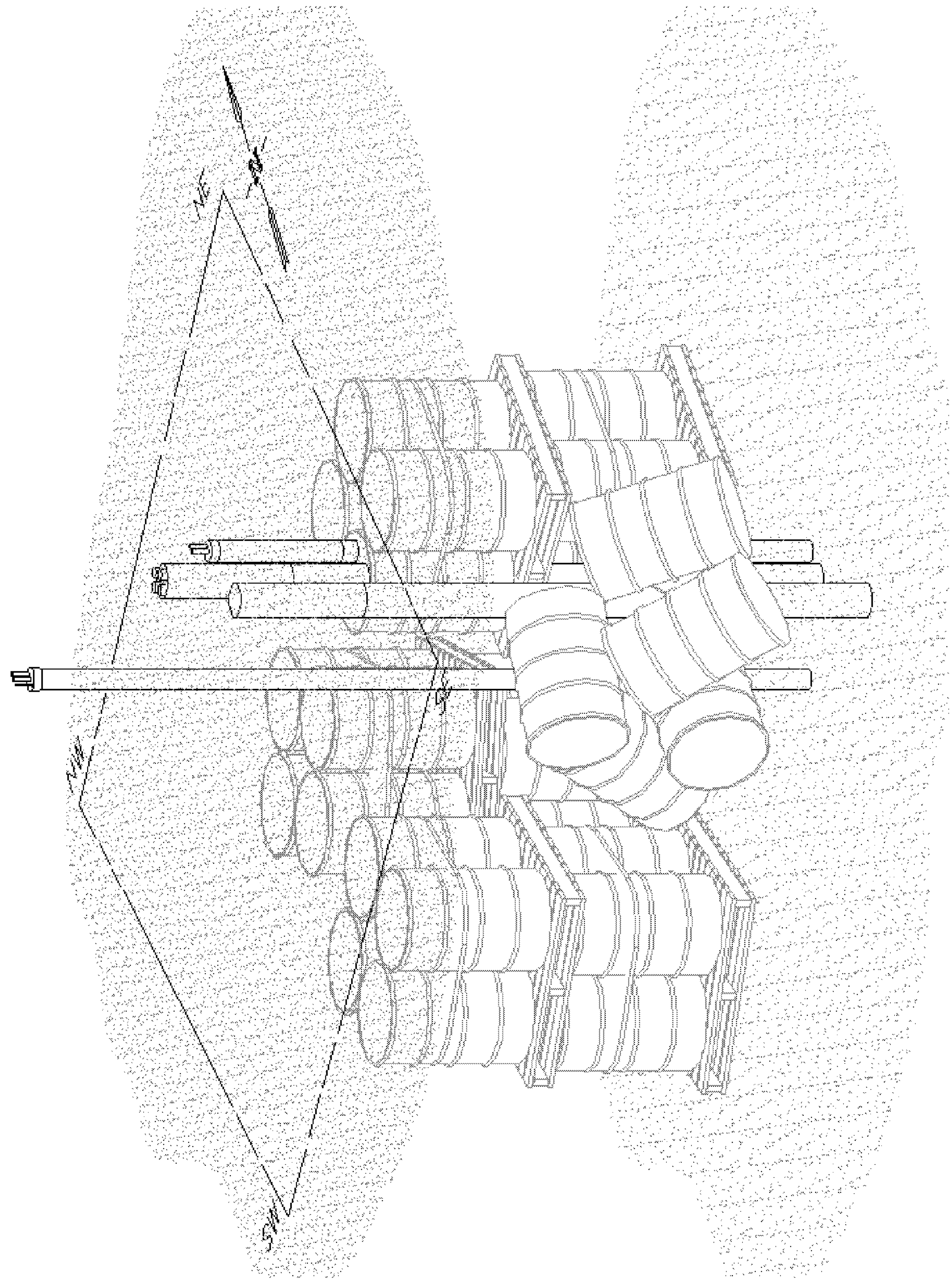



PIT 9 SURROGATE WASTE PIT, COLD WASTE PIT SOUTH, RWMC


N
NE
SE
SW
NW




PIT 9 SURROGATE WASTE PIT, COLD TEST PIT SOUTH, RWMC



# 3. COLD TEST PIT NORTH

## 3.1 In Situ Grouting Test Site - 1985 In Situ Grout Test Pit

The first test pit simulating RFP TRU waste buried in shallow landfill pits was constructed in 1985. The pit was constructed for the purpose of in situ grouting testing. The waste contents were chosen to simulate RFP waste types within the constraints of RCRA regulations. The construction technique was similar to that used at the SDA, excavation to basalt 1-3 ft under-burden 10-12 foot waste and 3 feet of soil cover. Used metal 55 gal drums and traditional 4×4×8 ft. plywood boxes were used to contain simulated waste material, paper and plastic trash, metal and simulated sludge.

The physical area selected for the pits was approximately 550 ft long × 100 ft wide with an approximate depth to basalt of 16 feet and a waste depth of 10 ft. The three pits were located adjacent to the north access road of the SDA. Two of the pits were in an area 1000 to 1250 feet west of the north east corner, almost across from Pad A, adjacent to USGS subsurface testing going on at the time. One trench was 700 ft from the NE corner. Each of the three 6×20 foot trenches was compartmentalized into three areas. Forty-five drums containing simulated waste were placed in the random and stacked drum areas, and 3 boxes containing mostly metal in the stacked box area. The later cold test pit described below devoted an entire pit to each one of these arrangements while following the waste compositional arrangement.

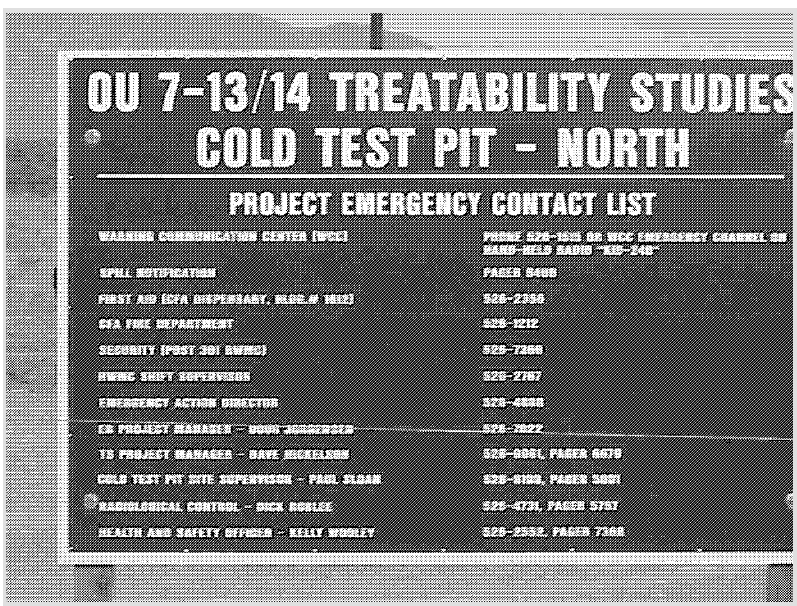
Two trenches are adjacent to each other on the west side of the area with the third 200-ft away on the east side. The contents of each trench simulated the waste volume fractions in the original TRU pits. Container type and total weight are summarized in Table 5.10 with details given in Annual Technology Progress Report EGG-2429 1985 and EGG- 2483, 1987. Further information on grout test and removal of this pit and preparation of the Cold Test Pit in the south area based on this test is given in the, EGG-2525, 1988.

A lance injection system was used for in situ low-pressure injection of 2,915 gal (390 ft$^3$) of cement grout through 52 grout holes in one of the test pits. This filled an estimated 50% of the available voids (67% of the total waste volume of 1200 ft$^3$ or 800 ft$^3$) The hydraulic conductivity of the waste pit decreased from $1 \times 10^{-3}$ cm/sec to $1 \times 10^{-5}$ cm/sec by grouting. Pictures of the grouted material after excavation are available in the progress reports and show that most waste containers were grouted but interstitial soil was not grouted. Most of the grouted simulated waste from both test cells was excavated and hauled to the sanitary landfill at CFA with some of the drums used in the cold test pit for the Large Object area (see the table). Two trenches on the west side were not grouted in the area and removed in 1988.

## 3.2 Dynamic Disruption Pit

A dynamic disruption test pit was constructed in 1999 for use as a possible preconditioning treatment for conventional ISV processing of buried waste sites at the SDA. The dynamic disruption equipment will be used to punch vent holes and collapse large void spaces in the simulated waste packages. Pit contents are summarized in table 6.8. The dimensions for the simulated waste seam in the Dynamic Disruption pit are 13 ′ 13 ′ 8’ deep, with an underburden thickness of 1 ft and an overburden thickness of 4 ft. Pit description and contents are summarized in table 5.11. The Dynamic Disruption test was conducted in 2000. The contents of the pit were excavated and the debris transported to the CFA landfill.


INEEL
ER TREATABILITY STUDIES
COLD TEST PIT - NORTH

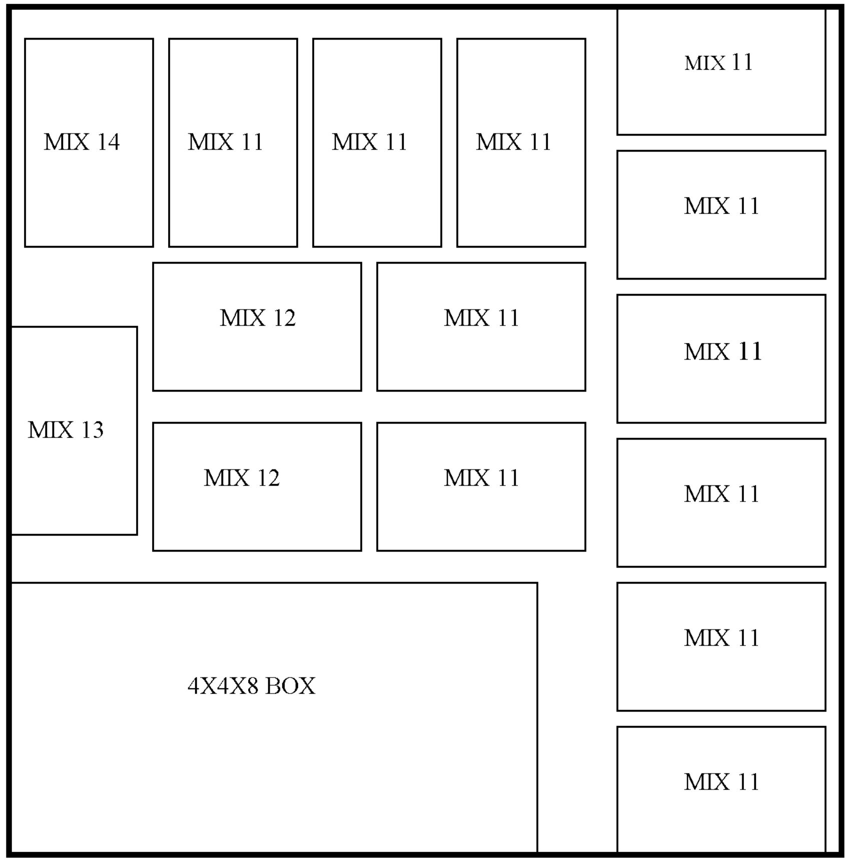

OU 7-13/14 TREATABILITY STUDIES
COLD TEST PIT - NORTH
PROJECT EMERGENCY CONTACT LIST

**Layer 1**

DYNAMIC
DISRUPTION
LAYER 1

DRUMS
MIX 11 - 11
MIX 12 - 2
MIX 13 - 1
MIX 14 - 1
TOTAL 15

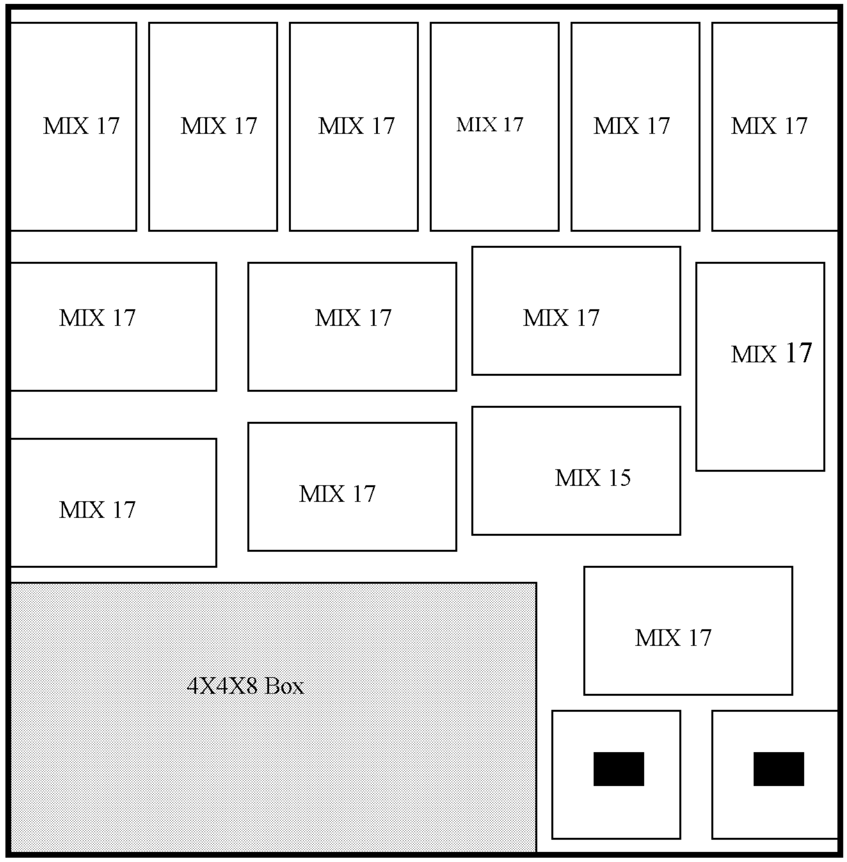
1- 4X4X8
BOX



**Layer 2**

DYNAMIC
DISRUPTION
LAYER 2

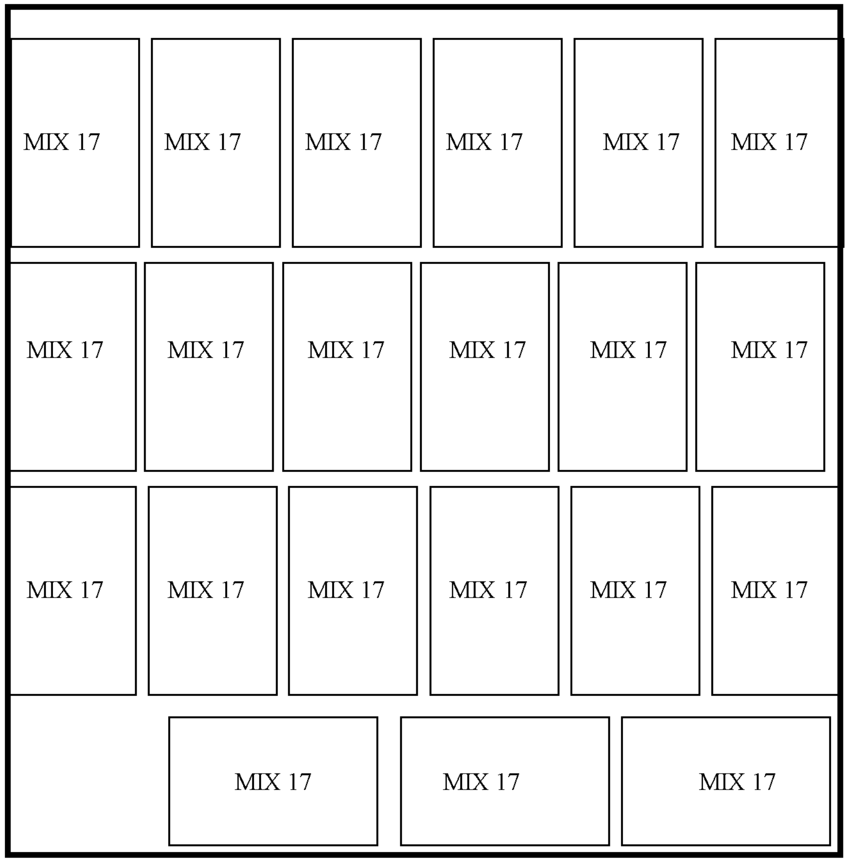
DRUMS
MIX 15 - 1
MIX 17 - 13
TOTAL 14
[redacted]



**Layer 3**

DYNAMIC
DISRUPTION
LAYER 3

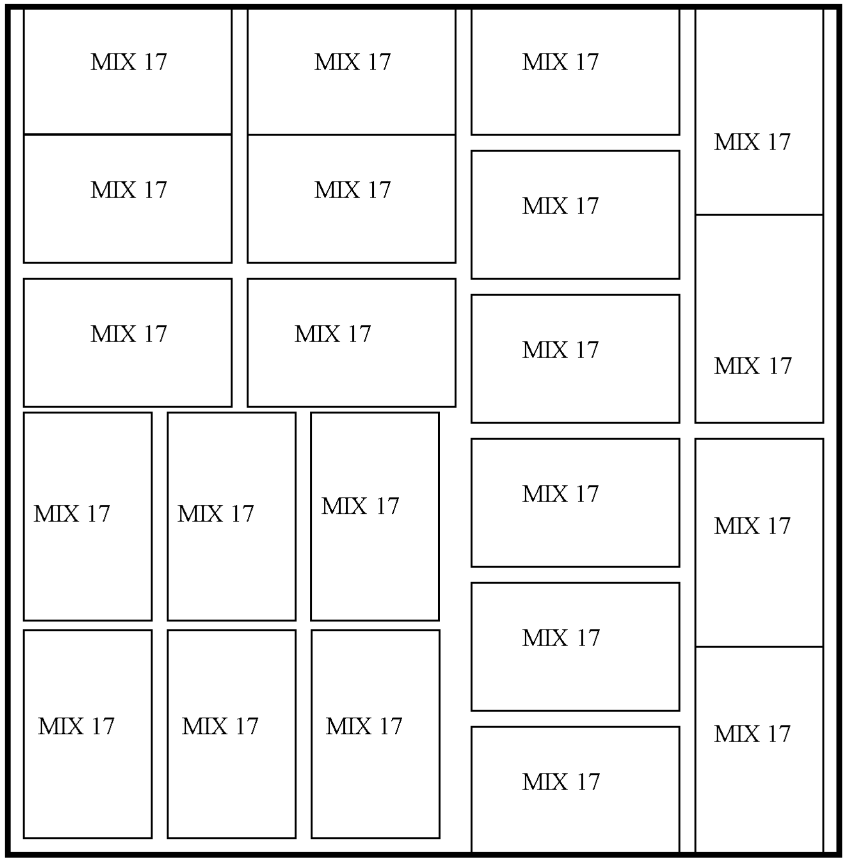
DRUMS
MIX 17 - 21
TOTAL 21



**Layer**

DYNAMIC
DISRUPTION
LAYER 4

DRUMS
MIX 17 - 22
TOTAL 22



# 3.3 In Situ Vitrification Pit

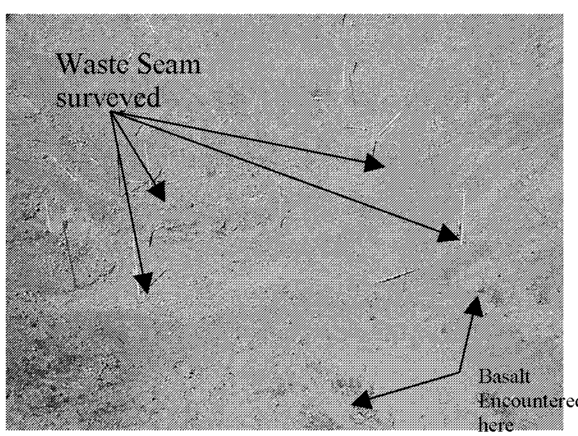
The ISV test pit was assembled in August 2000 at the Cold Test Pit North Area located north of the RWMC SDA. The pit is 18-ft square , 18-ft 9 in. deep with an 11-ft 9-in deep waste seam and 7-ft of overburden. An oxidizer trench, 4-ft wide and 4-ft high, extends 15-ft from the east side of the main pit and is at the same level as the top 4-ft of the waste seam. The waste seam is comprised of 5 layers of simulated waste positioned to simulate a modified random dump configuration. Nine of the simulated waste drums are instrumented, each with two TCs (Top and Bottom) and a Pressure Transducer (PT). The instrumented drums are located in the southeast quadrant of the pit bottom layer. The pit also has 3 horizontal and two vertical TC arrays arranged to measure melt growth during ISV processing of the test pit. The Oxidizer trench also is instrumented with a horizontal TC array extending the full length of the trench. The pit instrumentation leads and arrays have been located one above the other by surveying the bottom most leads and placing subsequent instrumentation on top of it to aid in probe location during later dynamic disruption activities. The array location for the Oxidizer Trench was also surveyed and its instrumentation leads were routed to the east. The following is a detailed description of the pit assembly process.

**Pit Excavation**

The pit was excavated in August of 1999. The bottom of the excavation is 20-ft square to allow flexibility in locating the pit. Pit depth is 18-ft 9-in. and isn't perfectly level on the bottom. The pit was somewhat deeper in the middle, but soil manually excavated from the instrument wire trenches was placed in the pit center to level it as much as possible. Pit waste seam bottom elevations are as follows:

| | |
|---|---|
| North East Corner | 4995.260 |
| North West Corner | 4994.930 |
| South East Corner | 4994.240 |
| South West Corner | 4994.160 |

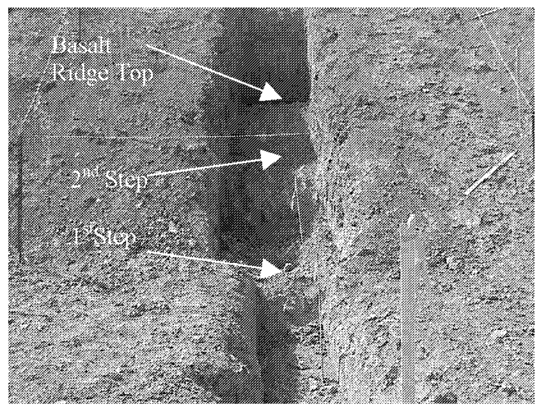
The east side of the pit was sloped to allow equipment access. The other three sides were sloped 1/1.5 to eliminate confined space concerns after excavation. When cutting the ramp in the east side of the pit, basalt was encountered forcing the slope to be slightly steeper than anticipated. Some basalt was also encountered at the 18 ft depth on the north east corner of the pit excavation.




Excavated
Pit

In July of 2000 it was decided to cut the instrumentation lead trench in the bottom and south side of the pit in preparation for waste seam assembly. The trench at the bottom of the pit was 2-ft deep and extended directly south of the pit. The trench was cut for routing container instrumentation leads underneath the waste seam and out to the surface, below and beyond the melt influence area. In the process of excavating the trench, a basalt ridge was encountered. The ridge has three steps, two of which interfere with placement of the pit instrumentation lower and middle horizontal thermocouple arrays. The top of the lower step is approximately at the same level as the bottom of the waste seam and was encountered a few feet from the pit waste seam edge. The Pit was resurveyed and the boundaries moved 2 ft to the north to minimize interference from the basalt ridge. Interference at the waste seam bottom level is encountered approximately 20-ft from the pit center. The ridge rises at that point to form a wall about 4-ft high. A second step recesses from the wall edge to approximately 25-ft from the pit center. The wall then rises another 4-ft to the top of the subsurface basalt ridge.  Later discussion will address accommodations for placement of the horizontal instrument arrays.

Excavated Pit/Instrumentation Trench

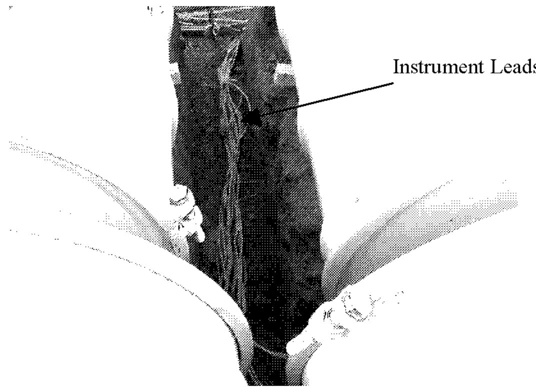



Instrument Trench/Basalt Ridge

### 3.3.1 Pit Assembly Layer-1.

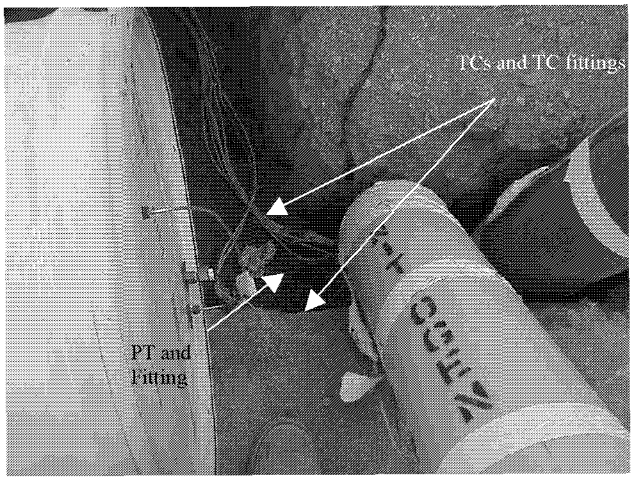
In placing the first layer (Layer-1) of the waste seam the 4X4X8-ft box and the 9 instrumented drums were set in place first. Locations between the drums and the box for the necessary instrumentation lead trenches were marked. The drums were then moved to enable access and the instrument trenches were dug by hand. Shovels barely scratched the surface of the undisturbed pit underburden. A hammer drill was used to cut the trenches and shovels were used to lift the soil out. The trenches were dug to an approximate depth of 2-ft below the pit bottom.

Setting Drums



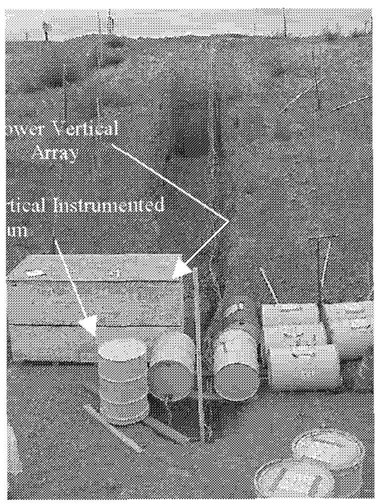

Instrument Trench
Between Drums

After trenching was completed the instrumented drums were individually placed. The lids on these drums were replaced with test lids that each had two 1/8-in. Swagelock tubing fittings and one 1/8-in pipe boss welded to them for thermocouple and Pressure Transducer (0-60 PSI) installation. The TC and PT penetrations are welded and placed approximately 2-in from the edge of the lids. The TC penetrations are on opposite sides of the lids (top and bottom) and the PT penetrations are located at the bottom. Instrument leads are routed down into the wire trenches and out the south side of the pit. All TC connectors are plug type connectors that have been wrapped in plastic and Duct Tape to protect them when the pit was back-filled. The TCs Sheathing was bent inside the drums so that the TC tips are touching the inside of the drum walls. Two gas cylinders were also placed in Layer-1 to determine heat transfer effects of the bottles when melting. The cylinder isolation valves were removed so no pressure will be developed during processing. Each cylinder has three TC weld tabs welded to them. The tabs are located at the top middle and bottom of the cylinders. During placement the TC sheath for the bottom TC for Cylinder 2 (45 deg. placement) cracked near the weld tab. The TC, internal to the sheath, did not appear to be damaged. The cracked weld tab/sheathing was reinforced with duct tape to prevent further damage when the cylinder was put in place.

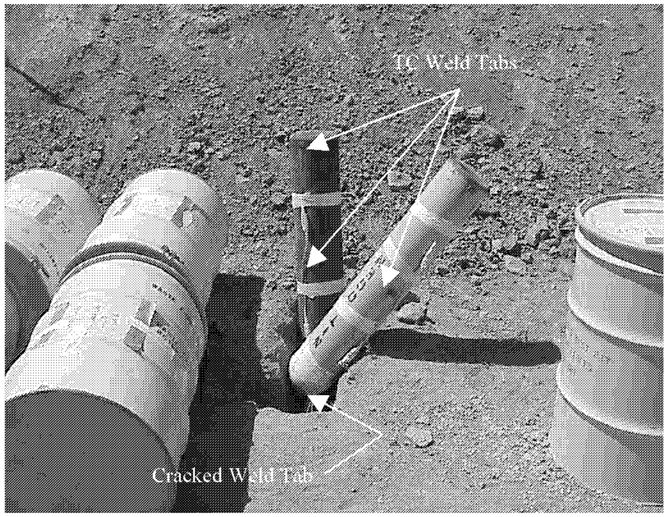



Drum Lid and Instrument Trench

The Lower Vertical Array was placed in the pit center with leads directed down to the instrument trenches and up the side of the pit wall. The Lower Vertical Array is a PVC pipe that contains thermocouples assembled to measure temperatures at 6-in. intervals from the bottom of the instrument wire trench extending 6.5-ft vertically into the waste seam (8.5-ft total length).



Instrumented
containers in place

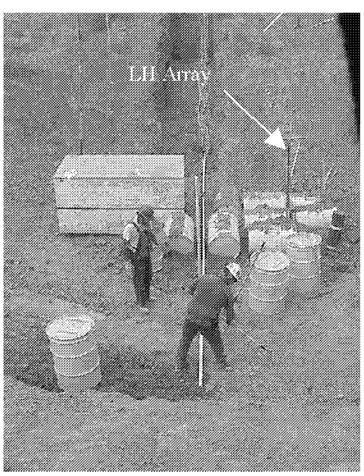



Gas Cylinder Placement

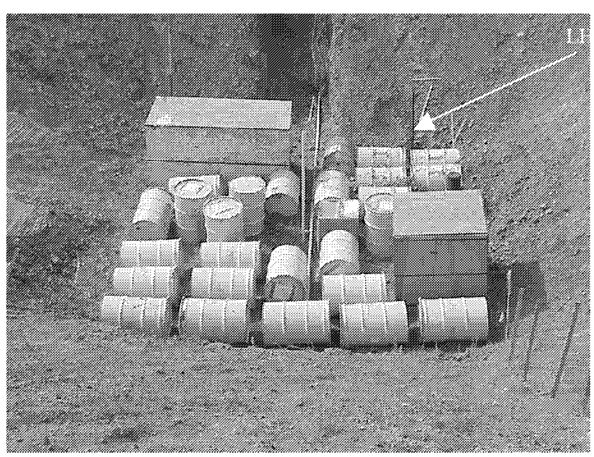
After placement of the instrumented containers, the instrumentation lead trenches were backfilled and voids removed by pushing/prodding soil into them with shovel handles. The Lower Horizontal (LH) TC array was then placed in the pit. The LH TC Array is a PVC pipe that contains thermocouples designed and assembled to measure temperatures at 2-ft intervals from the center of the test pit waste seam extending 28-ft horizontally out of the waste seam to the south (28.5-ft total length). As mentioned previously, the array could not be placed with its tip at the center of the waste seam. The LH array extends beyond the pit center to the north 8-ft, with 20.5-ft extending horizontally out of the waste seam to the south. As the melt radius should be a maximum 15-ft, the instrument leads for this array are placed well outside the melt influence area.

One instrumented drum was placed vertically in the pit with its lid facing down. One TC (TC-3) was extended its full 2-ft length into the drum and the other (TC-4) was extended approximately 3-in. into the drum to provide temperature profiling during melt operations. All container instrument leads were routed to the surface via the instrument trenches and individually marked to identify specific instrument types (TC/PT) and numbers. The lower horizontal TC array and instrument lead routing placement was also surveyed.

After instrumented container placement with the instrumentation leads routed and the instrumentation trenches backfilled, the remaining containers were then placed in the pit. Placement for all containers was completed as per the Pit Construction EDF pit map for Layer-1.




Instrument Trenches Backfilled



Layer-1 containers in place

| | | |
|---|---|---|
| CO-Combustibles | D-Drum | MT-Empty |
| IS-Inorganic Sludge | B-Box | ME-Metal |
| OS- Organic Sludge | # =Mix Number | CN-Concrete |
| NS- Nitrate Salt | G-Graphite | AS-Asphalt |
| DE-Debris | INS-Instrumented | CYL-Cylinder |
| ( )- Container Number | | |

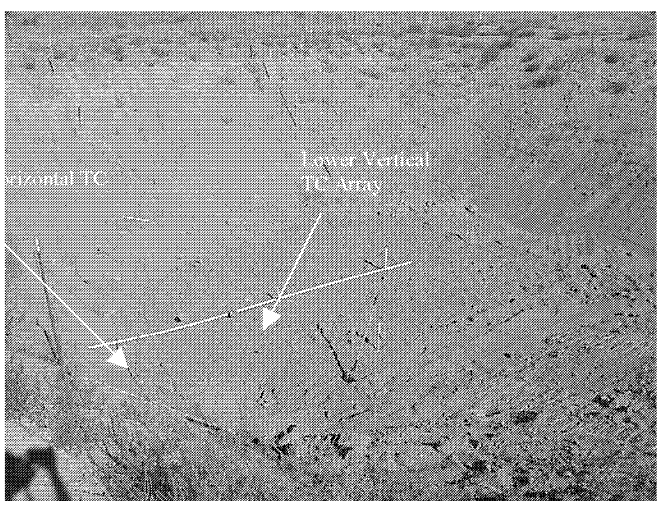

DRUMS
D1CO = 4
D6IS = 1
D7IS = 1
D8OS= 17
D29GR=1
D9NS= 2
TOTAL = 26

**LAYER 1**

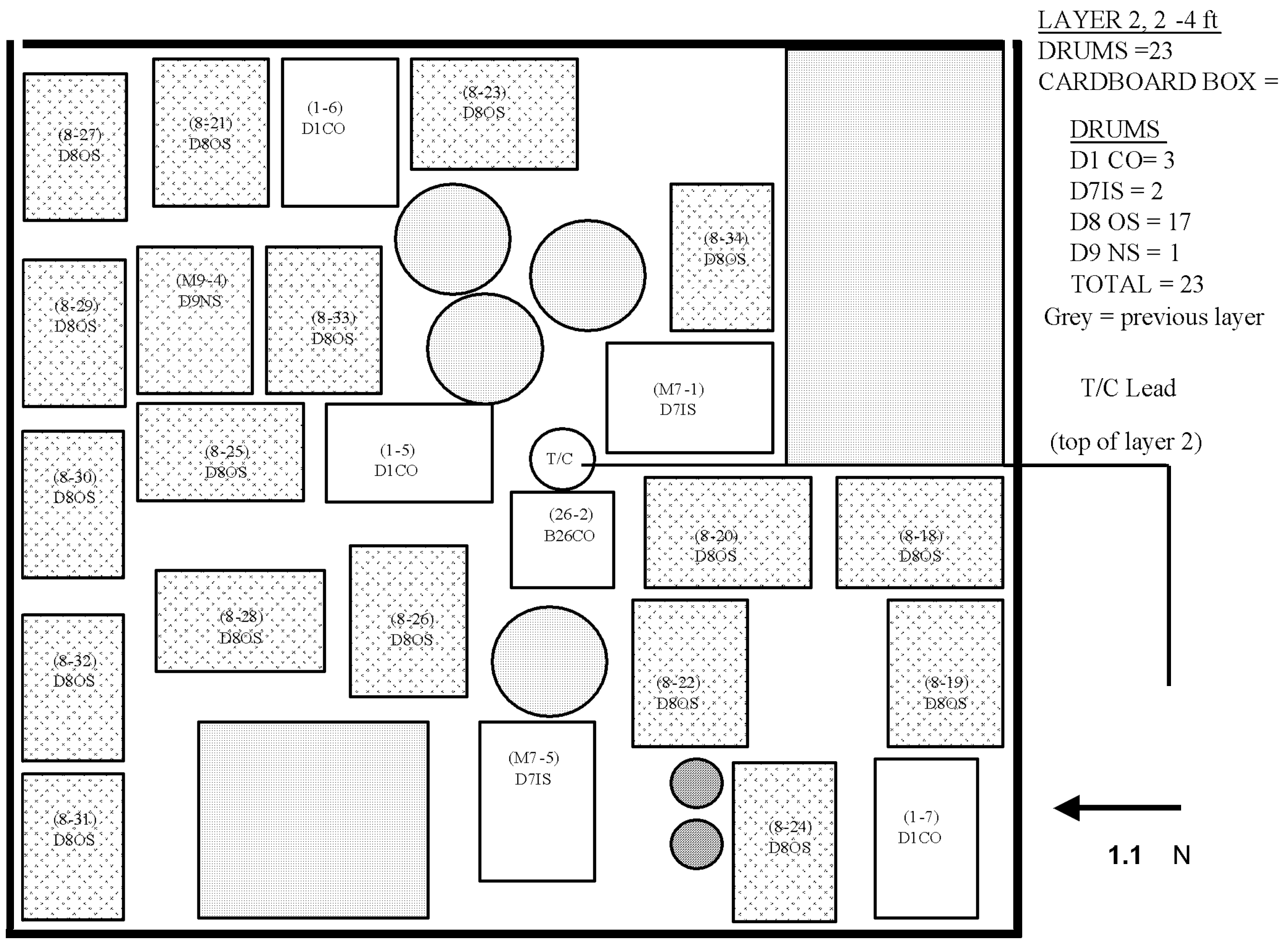
### 3.3.2 Layer-2

After the containers in Layer-1 were placed, backfill soil was added until the horizontal drums were covered with approximately 3-in. of soil. The boxes and vertical drums extended above the fill. Areas between containers were prodded with shovel handles to minimize voids caused by soil bridging. Soil outside the pit boundaries was compacted by driving dirt-moving equipment over it. The pit corners were then surveyed and marked, the area raked smooth and level, then Layer 2 containers were placed in the pit.

After Layer-2 containers were placed in the pit it was backfilled with soil until all containers were covered with approximately 3-in. of soil. The pit corners and horizontal TC array/instrument lead placement and routing were then surveyed and marked. The middle Horizontal TC array (same TC spacing/construction as the lower array) was then placed over the routing survey markers and the instrument leads routed out of the pit to the south. Again, due to interference with basalt, the Northern end of the array extended 32-in. beyond the lower vertical TC array (Pit Center).



The map below shows Layer-2 container placement and container identification information.



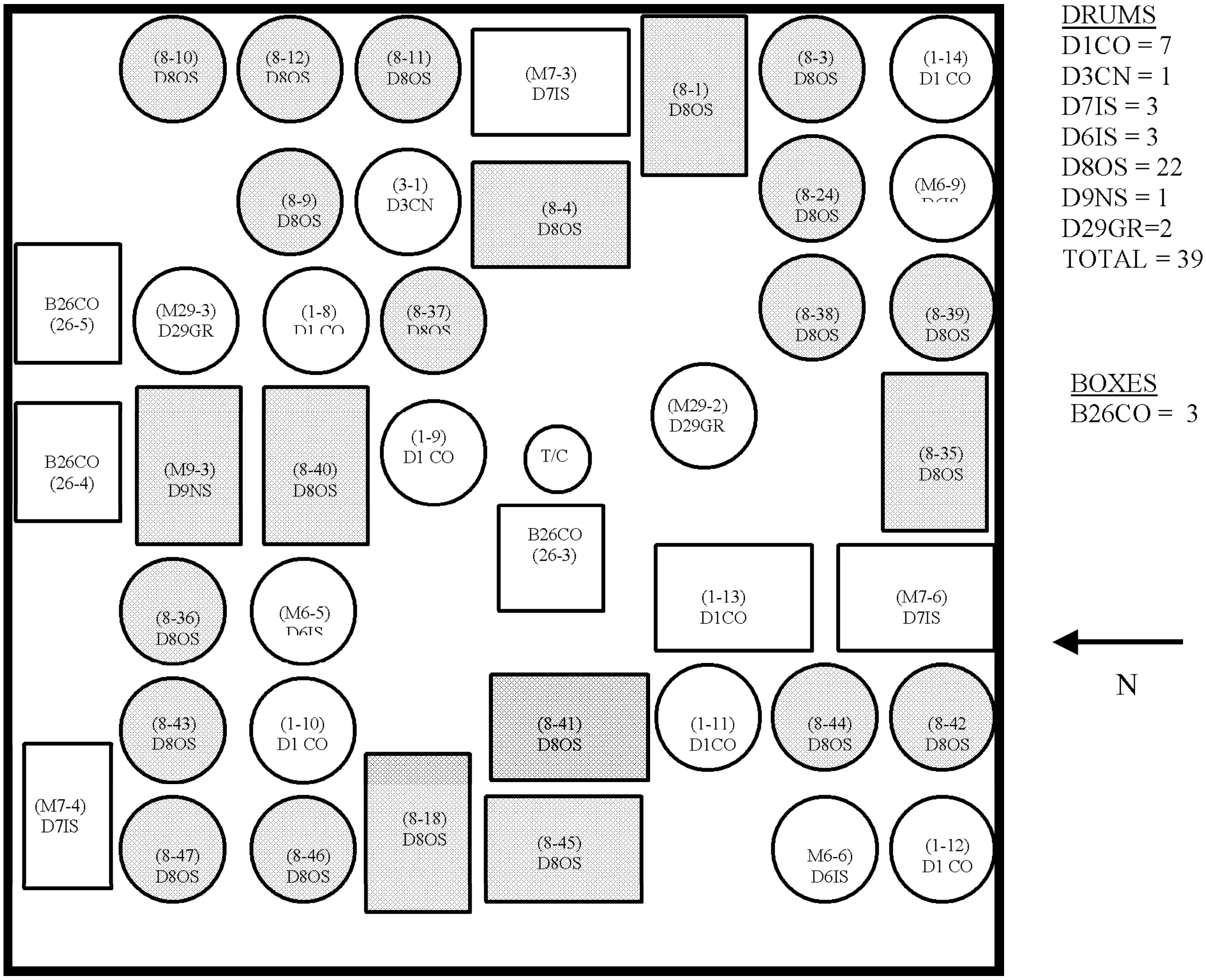

**Layer 2**

### 3.3.3 Layer-3

Layer-3 containers were placed in the pit, within the surveyed corner markers, over the raked and smoothed backfill and Middle Horizontal TC array. The Upper Vertical TC array was then fastened (taped) to the lower vertical array with a 1.5-ft overlap of the upper and lower vertical array tips. TCs in this array are spaced at 1-ft intervals and extend upward 11.5 ft.


Layer-3 containers

The map below shows Layer-3 container placement and container identification information.



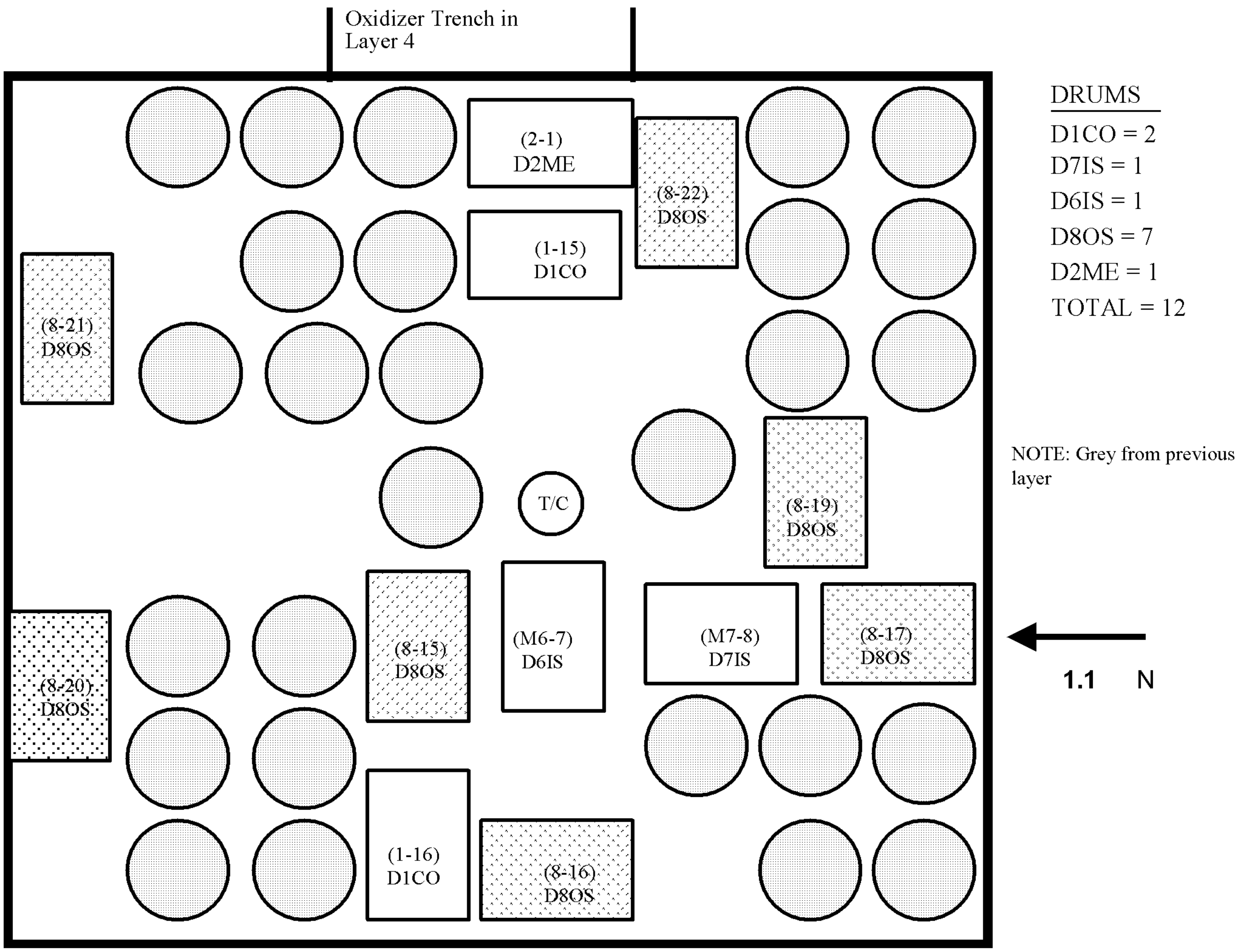

Layer-3 was then backfilled to approximately 3-in above all horizontally placed drums. Backfill was raked and smoothed with vertical containers penetrating the backfill surface. The pit corners were again surveyed and marked and Layer-4 containers were then placed. The bottom layer of the oxidizer trench was placed at the layer 4 level with the trench extending from the pit edge to the east. Oxidizer trench center and corner coordinates were also surveyed and marked. Holes were punched in the lower quadrant of each facing drum lid and bottom in the oxidizer trench to simulate worst case mixing between drums.

### 3.3.4 Layer 4

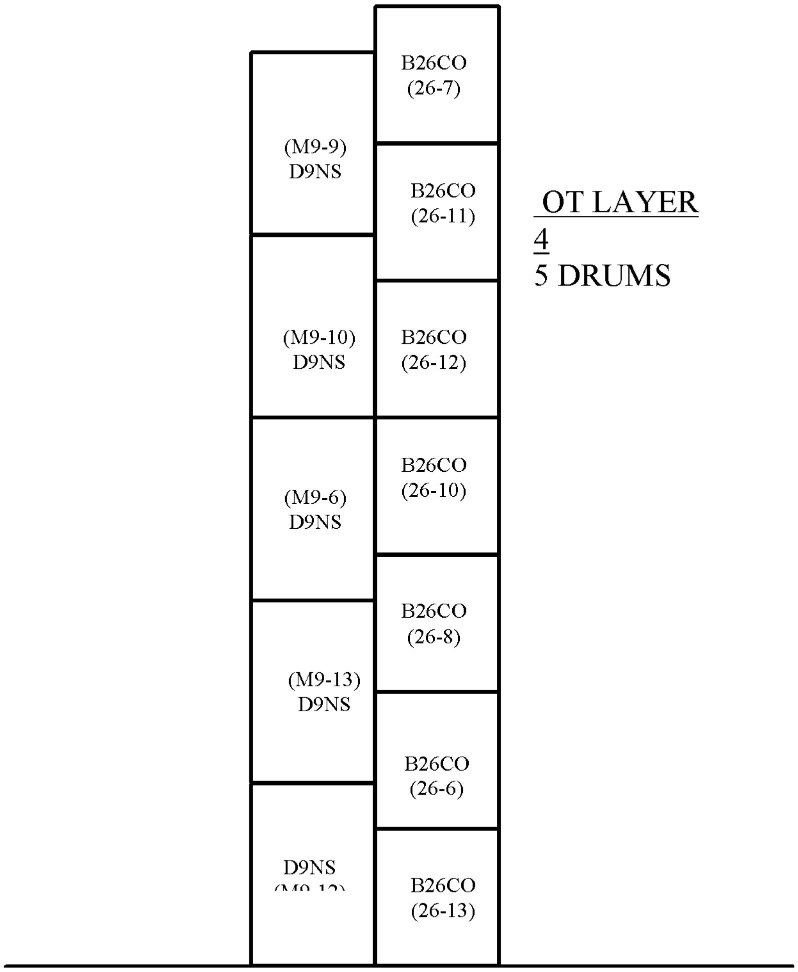

Layer-4 and Oxidizer Trench

Trench Drum Holes

The map below shows Layer-4 container placement and container identification information.



**Oxidizer Trench Layer 4**
**6-8 ft**




OT LAYER 4
5 DRUMS

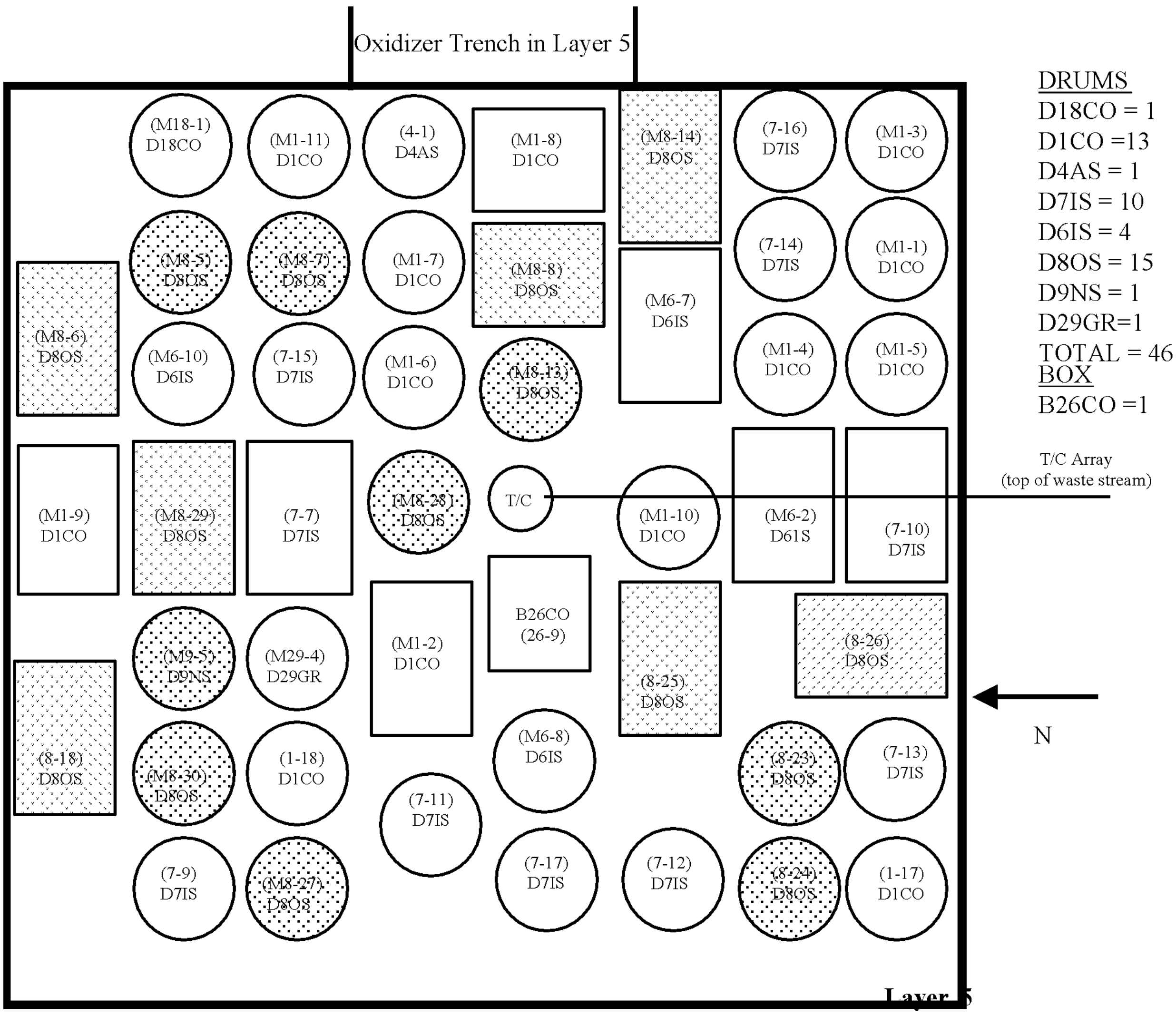
Layer 4 and the Oxidizer trench were then covered with backfill. Drums in the test pit were covered with approximately 3-in. of soil. No soil was placed between the 1st and second oxidizer trench levels to establish worst case. The oxidizer TC array was placed in the center and on top of the 1st layer containers.

Backfilled Layer-4 / Oxidizer Trench

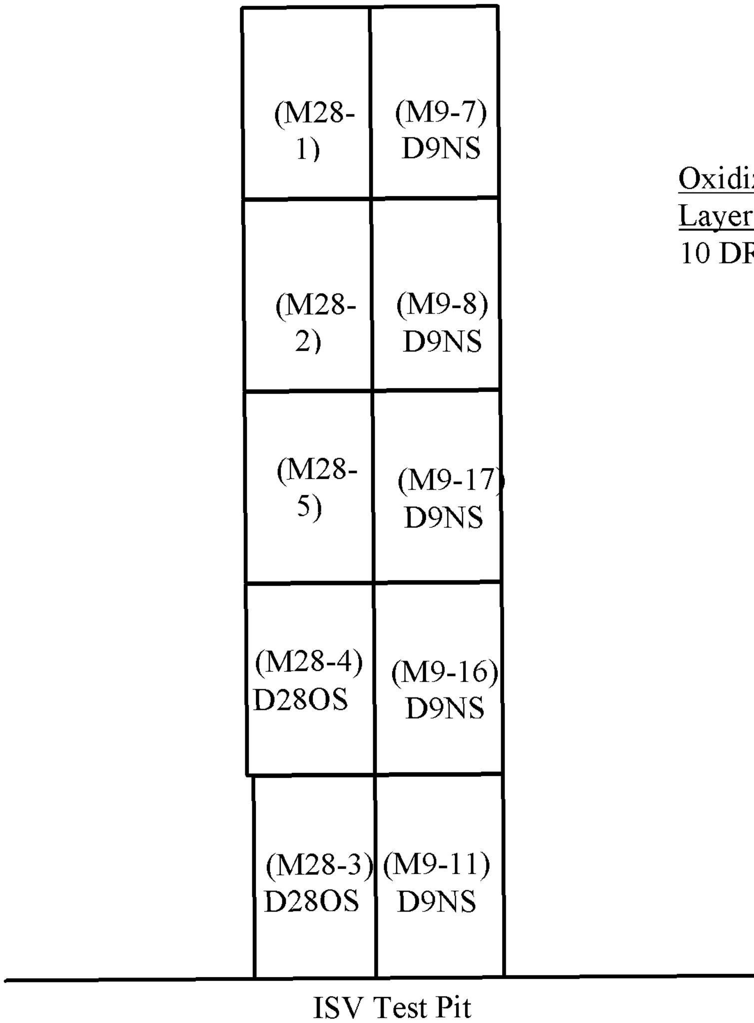
### 3.3.5 Layer-5

The Pit boundaries were again surveyed prior to placing Layer-5 and the Oxidizer Trench top layer. Discrepancies in the layer 5 map were noted during pit construction. The table on the map indicated there should be 13 D1CO drums, 10 D7IS drums, and 5 D6IS drums. The placement diagram originally showed 14 D1CO positions, only 8 D7IS positions, and 4 D6IS positions. Only 13 D1CO combustible drums were available, therefore, a D18CO (cardboard combustible) drum was substituted. Combustible drums now total 14. Two Positions were added to the map so that 10 D7IS drums could be placed as identified in the table. Only 4 D6IS drums were available, therefore only 4 were placed as indicated on the position map. A total of 46 drums were placed in Layer 5. This supports the ISV Work Plan and Pit construction EDF, each of which indicated there should be 161 total drums placed in the ISV test pit, including the Oxidizer Trench. The revised position map included below shows as-built container placement.

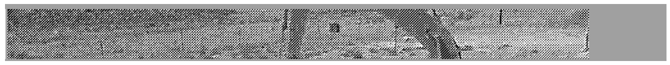
The map below shows Layer-5 container placement and container identification information.



Oxidizer Trench Layer 5
8-10 ft




Oxidizer Trench Layer 5
10 DRUMS



Layer-5 / Oxidizer Trench

### 3.3.6 Overburden/backfill placement

After placing the containers, Layer-5 and the Oxidizer Trench top layer were covered with backfill to approximately 6-in. above the vertical drum level (top of the waste seam). Survey points for positioning of the Upper Horizontal (UH) TC Array (same construction as before) and instrument leads were marked and the array was placed with its tip at the center of the pit touching the Upper Vertical TC Array. The instrument leads for the Oxidizer Trench TC Array were extended to the east up the equipment ramp approximately 30-ft prior to covering with soil. The Oxidizer Trench TC Instrument leads were then brought vertically to the surface from that point as the pit was backfilled. Backfill of the pit continued until the grade level reached the top of the Upper Vertical (UV) TC Array. Survey markers were then installed for placement of the UV TC Array Instrument leads that were routed to the remainder of the instrument Trench cut into the south side of the pit.

Backfill was continued until the pit was at grade. Compaction around and over the pit was accomplished by driving dirt-moving equipment over the pit. All instrument leads from the pit, with the exception of the Oxidizer Trench, were gathered at a single point on the south side of the pit. The leads were coiled and placed underneath a 4X4X4 wood box to provide protection from weather and vehicular traffic. The Oxidizer Trench leads were coiled and placed under an open-headed 55-gal drum for protection. The Pit corners were surveyed and marked and a fence was placed around the pit area to keep traffic from running over the pit.

# 4. MULTIPLE SUBSURFACE MAPPING/GEOPHYSICAL/SITE/WASTE CHARACTERIZATION PROJECTS

These Studies/Projects were reported in Buried Waste Integrated Demonstration Program Reports, DOE/ID-10454 and FY-95 Technology Catalog, DOE-ID 10513 and are summarized below.

## 4.1 Thermal Infrared Imaging System, 1992

Demonstrate an airborne infrared sensor method to detect and map ordnance and buried waste.

## 4.2 Magnetic and Electromagnetic Geophysical Surveying, 1992

To demonstrate how efficiently airborne magnetic and electromagnetic devices can map buried waste sites and characterize subsurface waste objects.

## 4.3 Rapid Geophysical Surveyor, 1993

Design, construct, and demonstrate a device to quickly and inexpensively characterize buried waste sites by collecting high quality, dense sets of magnetic data.

## 4.4 Remote Characterization System, 1993

Demonstrate the feasibility of remote, high precision characterization of buried waste by deploying and operating a remote vehicle over a waste site.

## 4.5 Ground Penetrating Radar, 1994

Perform a multidiscipline assessment of existing underground radar techniques, particularly as they relate to dielectric properties and attenuation as a function of radar wave frequency and the mineralogy at the INEEL.

## 4.6 Tensor Magnetic Gradiometer System, 1994

Develop and demonstrate site characterization and object location using a tensor magnetic gradiometer applied specifically to DOE buried waste sites.

## 4.7 Broadband Electromagnetics, 1994

Demonstrate and further develop three-dimensional waste site delineation by broadband electromagnetics.

## 4.8 Non-intrusive Characterization and Sensing of Buried Objects, 1994

Collect a geophysical data set of high spatial density with multiple sensors, integrate the interpretations, and develop imaging and display formats readily understood by environmental scientists and engineers.

## 4.9 Rapid Transuranic Monitoring Laboratory, 1994

Develop a field deployable Rapid Transuranic Monitoring Laboratory that can continuously monitor airborne transuranic concentration and rapidly analyze soil, smear, and air filter samples for transuranic isotopes and fission and activation products.

## 4.10 Digface Characterization, 1995

Develop and test geophysical chemical, radiological, and environmental sensors to provide constant surveillance and screening for all categories of hazards at the digface during excavation.

## 4.11 Very Early-Time Electromagnetic System, 1995

Design a high-resolution electromagnetic imaging system for shallow environmental problems (less than 10 meters) such as buried waste sites.

# 5. REFERENCES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